

Dissertation On

**ULTRASONOGRAPHIC EVALUATION OF
PAINFUL SHOULDERS AND CORRELATION OF
ROTATOR CUFF PATHOLOGIES AND CLINICAL
EXAMINATION**

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BONAFIDE CERTIFICATE

This is to certify that the study entitled
**“ULTRASONOGRAPHIC EVALUATION OF PAINFUL
SHOULDERS AND CORRELATION OF ROTATOR CUFF
PATHOLOGIES AND CLINICAL EXAMINATION”** is the bonafide
work done by Dr.M.A. UMA DEVI, M.D., P.G. at the Barnard Institute
of Radiology, Madras Medical College, Chennai.

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Degree in Radiodiagnosis.

Director
Barnard Institute of Radiology
Madras Medical College,
Chennai - 3

Dean,
Madras Medical College,
Chennai - 600 003

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INTRODUCTION

Shoulder pain is one of the most common complaints encountered in clinical practice and frequently results in considerable morbidity. Its cause is related to many different pathologies and articular structures and periarticular soft tissues may be involved. For this reason, it is often difficult to detect and identify the site of anatomical alteration with clinical examination alone.

Many clinical diagnostic tests have been developed for the physical examination of the shoulder girdle but suffer from lack of accuracy. Although a complete history, physical examination and review of plain radiograph by an experienced examiner were found to be sufficient for establishing the diagnosis and treatment plan, magnetic resonance imaging still had a significant impact on clinical decision making a large subset of patients with shoulder pain. Given the great improvement in resolution achieved by high-frequency ultrasound, it is expected to serve as an important tool for the accurate evaluation of painful shoulder.

Even before advanced imaging (US & MRI) is performed, the diagnosis of rotator cuff tear can be suggested at clinical examination (1-4) & with radiography of the shoulder.

Ultrasonography has been established as an effective imaging method in the evaluation of the rotator cuff. Specific US criteria have been used to correctly diagnose rotator cuff tears(5) . These include nonvisualization of the rotator cuff or focal tendon defect to indicate a full-thickness tear, flattening of the bursal surface to indicate a bursal side partial-thickness tear, and a distinct hypoechoic or mixed hyper- and hypoechoic defect at the articular surface to indicate an articular side partial-thickness tendon tear(6).

Because of the difficulty in diagnosing some rotator cuff tears with US, various associated secondary signs have been described. These include greater tuberosity cortical irregularity (7,8), fluid within the subacromial-subdeltoid bursa , and joint effusion(9,10) . The reported usefulness of each of these signs is variable, and the results are often conflicting. Relatively less is known about the US appearance of tendinosis. Tendinosis, or tendinopathy, can be defined as tendon degeneration. The term tendinosis is preferred over tendinitis, because eosinophilic, fibrillar, and mucoid degeneration are present, and acute inflammation is typically absent.

Bachman et al (11) demonstrated that supraspinatus tendon degeneration might appear hypo- or hyperechoic at US. Differentiation from tendon tear may be difficult, as both tendinosis and tendon tear may appear hypoechoic and coexist within the same tendon.

We discuss the clinical & US evaluation of rotator cuff pathologies with an emphasis on US technique and interpretation of US findings.

AIM OF THE STUDY

1. To identify ultrasonographic shoulder abnormalities
2. Compare physical examination with ultrasonographic findings especially rotator cuff abnormalities in patients with shoulder pain
3. Arrive at a differential diagnosis for shoulder pain

ANATOMY OF THE SHOULDER MUSCLES AND TENDONS

Many muscles are attached to different parts of the shoulder, and they are used to move the arm about in space. The deltoid muscle is attached to the shoulder blade along the spine of the scapula (the acromion) and also attaches to part of the clavicle. This muscle crosses the shoulder joint and attaches to the humerus halfway down the bone. The deltoid is the strongest shoulder muscle. It lifts your arm up and away from the side of the body and this type of motion is called "abduction." Underneath the deltoid muscle is the rotator cuff of muscles.

The rotator cuff is a group of four muscles that form a strong cuff around the shoulder joint and are the muscles that help to control the rotation and position of the arm. Each of these muscles has a tendon at the end that attaches to the humerus by growing directly into the bone. These four muscles are:

- The subscapularis
- The supraspinatus
- The infraspinatus
- The teres minor

The subscapularis muscle is attached to the deep surface of the scapula and then travels in front of the humeral head. It fits into a bump of bone on the humerus called the lesser tuberosity. The subscapularis also plays a very important role in preventing the shoulder from slipping out of the front of the joint.

The three other muscles of the rotator cuff are all attached to the back of the scapula and travel behind the humeral head. The supraspinatus, infraspinatus, and teres minor all insert on a bump of bone called the greater tuberosity. These three muscles together are called the posterior rotator cuff. They externally rotate the arm and also help to bring the arm down to the side of the body (adduction). The supraspinatus muscle and tendon can be considered the weak link in the shoulder, since the supraspinatus muscle is the most commonly injured part of the rotator cuff. This muscle begins on the top and back of the shoulder blade and travels along the top of the head of the humerus. The ceiling of the space that this muscle travels in is formed by the acromion, and it is in this space that the muscle is very vulnerable to wear and tear and injury.

Long head of biceps arises from the supraglenoid tubercle of the scapula (intracapsular) and inserts into the posterior part of the tuberosity of the radius.

CLINICAL EXAMINATION

The supraspinatus muscle aids not only in stabilization of the shoulder joint but also in abduction of the arm. To test for weakness, the patient's arm is straightened and then abducted 20° . The patient is then asked to abduct the arm against an applied force. Alternatively, supraspinatus strength can be assessed with the arm in the "empty can" (Jobe test) or "full can" position, the arm being elevated 90° in the scapular plane. In the empty can position, the arm is in full internal rotation with the thumb pointed down, whereas in the full can position, the arm is in 45° external rotation with the palm facing up(12).

Clinical impingement syndrome is characterized by pain during use of the shoulder that is relieved by local subacromial anesthetic injection. The pain can be due to (a) subacromial impingement from, for example, osteophytes (outlet impingement) or (b) intraarticular causes such as underlying instability or labral lesions (nonoutlet impingement) (13). To test for impingement, the patient's arm is passively elevated to at least 170° , which maximizes contact between the acromion and underlying structures. The arm is then internally and externally rotated while adducted against the ear. If there is increased pain with either internal or external rotation, the test is positive. In addition, assessment

for the arc of pain sign may be performed by having the patient actively lower the arm in the abduction plane. The test is positive when the pain is minimal at full elevation and increases as the arm descends, being maximal between 70° and 120° of abduction.

To test for weakness of external rotation (ie, by evaluating the infraspinatus and teres minor muscles), the patient is positioned with the elbow flexed 90° and the shoulder internally rotated 20°. The patient is then asked to resist an inward force.

Finally, the lift-off test can be performed to evaluate the subscapularis(14). This test is performed by passively positioning the patient's arm behind the back with the palm facing outward . Failure to hold the forearm and hand off the back or inability to push off against the examiner's hand constitutes a positive test. In their report on 16 patients with isolated subscapularis tendon tears, Gerber and Krushell (14) noted that 13 patients were unable to hold the forearm off the back, whereas three were unable to push off against the examiner's hand. Weakness of internal rotation is not a reliable indicator of subscapularis tear because there are other internal rotators of the humerus, such as the pectoralis muscle.

US APPEARANCES OF DISEASE

Tears of the rotator cuff tendons are classified as either full thickness or partial thickness. Full-thickness tears extend from the bursal surface to the articular surface. Partial-thickness tears are focal defects in the tendon that involve only the bursal or articular surface.

Full-thickness rotator cuff tears usually appear as hypoechoic or anechoic defects in which fluid has replaced the area of the torn tendon . Fluid in the region of the torn tendon can also allow increased through-transmission of the ultrasound beam, accentuating the appearance of the underlying cartilage. Thus, two hyperechoic lines representing the cartilage and the cortex are seen,producing the "double cortex" or "cartilage interface" sign. Furthermore, compression over the focal hypoechoic defect will displace the fluid and produce loss of the normal convex contour of the peribursal fat. Loss of normal contour may be seen even without compression if there is no fluid present in the area of the torn and retracted tendon. In this situation,depression of the overlying hyperechoic peribursal fat into the tendon gap occurs, creating the "sagging peribursal fat" sign . Atrophy of the muscle, which manifests at US as increased echogenicity and decreased bulk of the

muscle, has also been associated with tears of the tendon, with tears noted in 77% of examinations that demonstrate muscle atrophy(16).

Finally, in massive tears of the supraspinatus tendon, the tendon may be retracted under the acromioclavicular joint and not visualized at US. Thus, direct signs of tear include non-visualization of the supraspinatus tendon and hypoechoic discontinuity of the tendon, whereas indirect signs include the double cortex sign, the sagging peribursal fat sign, compressibility, and muscle atrophy.

Partial-thickness tears manifest as focal, well-defined hypoechoic or anechoic defects in the tendon but involve only the bursal or articular surface. The extension of the hypoechoic defect to the bursal or articular surface should be visualized in two orthogonal imaging planes to confirm the finding. Cortical pitting and irregularity can also be seen with partial-thickness tears. Van Holsbeeck et al (17) reported a sensitivity and a specificity of 93% and 94%, respectively, for detection of partial-thickness tears of the rotator cuff at US.

The subscapularis tendon can also be torn, usually in combination with a supraspinatus tendon tear; isolated subscapularis tears are relatively rare. With rupture or articular surface tear of both the

subscapularis tendon and the coracohumeral ligament, the long head of the biceps tendon can dislocate medially or become subluxated onto the lesser tuberosity. The biceps tendon can also become subluxated in the absence of a subscapularis tendon tear due to rupture of only the coracohumeral ligament (18,19) .

Not all pain and weakness of the shoulder are due to rotator cuff tears, and other potential clinical mimics of rotator cuff tears, such as supraspinatus tendinosis, calcific tendinitis, subacromial sub-deltoid bursitis, greater tuberosity fracture, and adhesive capsulitis, must be distinguished (18).

Tendinosis represents mucoid degeneration of a tendon without inflammation. Tendinosis is radiographically occult but can be detected at US. The tendon is thickened and heterogeneous with-out discrete defects, and an ill-defined hypo-echoic defect with indistinct borders may be present.

In calcific tendinitis, there is deposition of calcium hydroxyapatite within the tendon. Calcium deposition is seen in the supraspinatus tendon just superior or medial to the greater tuberosity at radiography and manifests as a discrete, linear hyperechoic focus within the tendon at US . Posterior acoustic shadowing may be seen at gray-scale US, and hyperemia may be seen at power Doppler US(20).

Subacromial subdeltoid bursitis is a contained collection of fluid that is superficial to the supraspinatus tendon. This inflammatory condition extends distally to the insertion of the supraspinatus tendon on longitudinal images and is often seen first on transverse or sagittal images of the biceps tendon, since this is usually the first structure to be evaluated. Unlike a joint effusion, the fluid is superficial to and not within the biceps tendon sheath.

Fractures are usually radiographically evident but can also be detected at US, which depicts a fracture as a cortical step-off or discontinuity. Cortical irregularity, however, can mimic and should not be mistaken for a fracture(21).

Adhesive capsulitis, or "frozen shoulder," is a clinical syndrome of shoulder pain, both at rest and with movement, that is caused by progressive thickening, fibrosis, and retraction of the joint capsule. Adhesive capsulitis can be distinguished clinically from rotator cuff tears on the basis of severe restriction of passive movement but can appear similar to chronic rotator cuff tears at radiography(22) . At dynamic US, the diagnosis can be suggested by restriction of the sliding movement of the supraspinatus tendon underneath the acromion during abduction of the arm (23). The diagnosis can then be confirmed with arthrography, which demonstrates decreased joint volume.

CAUSES OF MISINTERPRETATION

TECHNIQUE-RELATED

Anisotropy.

A common cause of false-positive diagnoses of rotator cuff tears is anisotropy or angle-dependent appearance of tissue structures. Anisotropy of fibers was first described by Dussik et al in 1958(24).

The rotator cuff appears echogenic when the ultrasound beam insonates at 90° to the long axis of the tendon fibers because the beam is then reflected maximally . The more the angle deviates from this angle, the fewer reflected sound waves will be detected by the transducer. The tendon becomes isoechoic to muscle at angles of 2° – 7° and hypoechoic at greater angles . Tendon insertions, where most rotator cuff tears occur, are most vulnerable to the anisotropic artifact due to their curved course(25). If unaware of this artifact, less experienced scanners could erroneously take this for tendinosis or a partial-thickness rotator cuff tear.

Transducer Positioning

The position of the transducer is related to the long or short axis of the anatomic structure under examination. When imaging the supraspinatus tendon in the transverse direction (ie, the short axis), the transducer is placed in a sagittal plane with regard to the patient's shoulder and is moved anterior to posterior following the course of the tendon . When the transducer has reached the most lateral part of the supraspinatus tendon insertion at the greater tuberosity, no rotator cuff can be visualized between the deltoid muscle and the humeral head . This could be misinterpreted as a full-thickness rotator cuff tear. To prevent making such an error, every possible lesion should be verified in two planes.

If performed correctly, US allows reliable detection and quantification of rotator cuff tears(6) . Both the Crass position(26) and the modified Crass position(27) reflect the true size of supraspinatus tears in the transverse plane. However, in the sagittal plane, the Crass position is more useful to quantify supraspinatus tears, as the modified Crass position leads to overestimation of the size of such tears(28) .

Acoustic Shadowing by the Deltoid Septum.

The deltoid muscle is a large triangular muscle that consists of anterior, intermediate, and posterior parts. The intermediate or central portion of the deltoid muscle, which arises from the acromial process, consists of oblique fibers. These fibers arise from the sides of four tendinous intersections and insert at the sides of three other tendinous intersections. These tendinous intersections pass alternately downward and upward toward one another in the substance of the muscle.

The anterior and posterior parts of the deltoid muscle, which arise from the clavicle and the spine of the scapula, are not arranged in this manner. The tendinous intersections cause an acoustic shadow (ie, a refractile shadow) when they are relatively thick or scanned tangentially. Acoustic shadowing occurs at an interface between tissues that transmit sound at different velocities. It is characterized by reflection of sound away from the transducer. This causes a hypoechoic area within the tendon, which can simulate a rotator cuff tear. This shadowing decreases or disappears when the transducer is moved to other positions, whereas a true tear remains unchanged in appearance.

Transducer Frequency.

US of the shoulder should be performed with a high-frequency transducer of at least 7.5 MHz. Examinations performed with a 5-MHz transducer show disappointing results. Nowadays, high-resolution transducers (multifrequency broadband, 7.5– 15 MHz) with adequate tissue penetration are available. Linear-array transducers are preferred because of their high resolution and because curved-array and mechanical sector transducers are more vulnerable to anisotropic artifacts .

Focusing

Small or partial-thickness rotator cuff tears may be missed due to suboptimal focusing, which diminishes spatial resolution. Therefore, the near field should constantly be adjusted to the depth of the structure under examination.

Imaging Protocol.

The rotator cuff tendons and especially the supraspinatus tendon are, in the neutral position of the arm, generally hidden underneath the acromion. However, for reliable sonographic evaluation, the tendons

need to be totally exposed. This can be achieved with a standardized imaging protocol.

Recent technical developments such as transmit compounding, extended- four-dimensional imaging may improve performance. However, to date no such studies are available. Despite these advances, rotator cuff tears may be missed due to limited movements of the shoulder. This is especially the case for the supraspinatus tendon, where about 90% of rotator cuff disease is located (the anterior part)(25) . Dynamic evaluation of the rotator cuff may be helpful for identifying nonretracted full-thickness rotator cuff tears by looking for separation of the margins of a tear. It can also be helpful in overcoming anisotropic artifacts (eg, the subscapular tendon). In addition, subluxation or dislocation of the long head of the biceps tendon(40) can be diagnosed by means of external rotation of the forearm. Instability of the shoulder may be diagnosed with dynamic examinations; however, in these cases MR imaging is frequently the imaging modality of first choice.

Transducer Handling.

Increasing the pressure of the transducer facilitates the identification of nonretracted full-thickness rotator cuff tears. On the

other hand, pressure should be eased to detect tiny fluid collections in the bicipital tendon sheath and subacromial-subdeltoid bursa. The detection of fluid in the subacromial-subdeltoid bursa or in both the joint and the subacromial-subdeltoid bursa is highly specific (96% and 99%, respectively) and has a high positive predictive value (70% and 95%, respectively) for the diagnosis of associated rotator cuff tears in symptomatic patients(38).

ANATOMY-RELATED CAUSES OF MISINTERPRETATION

Errors caused by failure to recognize normal anatomy are diverse. They can be overcome by studying anatomy, thorough supervision by an experienced colleague, and by comparison with the contralateral side.

Rotator Cuff Interval

The rotator cuff is a continuous tendinous structure around the shoulder joint formed by the tendons of the subscapular, supraspinatus, infraspinatus, and teres minor muscles. There is one single discontinuity, which is named the rotator interval. The rotator interval contains the long head of the biceps tendon, which descends from the glenohumeral joint through the interval into the bicipital groove. The rotator interval has a triangular shape, which is composed of the coracohumeral

ligament and the superior glenohumeral ligament and envelops the anterior margin of the supraspinatus tendon and the superior margin of the subscapular tendon(29) . The rotator interval varies in size and may not be apparent in some individuals(30) .

At sonography, the rotator interval is a hypoechoic area surrounding the cross-sectioned long head of the biceps tendon; this area could be mistaken for a rotator cuff tear by less experienced radiologists. This problem can be overcome by looking for the rounded edge of the anterior part of the supraspinatus tendon and by verifying the biceps tendon by following it into the bicipital groove. The rotator interval is best evaluated with the arm in external rotation or by externally rotating the glenohumeral joint slowly(31) .

Supraspinatus-Infraspinatus Interface

Focal thinning of the rotator cuff is a feature of a rotator cuff tear(32) or can be seen in an atrophic but intact cuff, particularly in patients with rheumatoid arthritis. Bretzke et al(33) showed that thinning of the rotator cuff at the supraspinatus-infraspinatus interface is a normal finding and should not be mistaken for a partial- thickness tear. One should be aware of this normal anatomic difference in rotator cuff thickness. Comparison with the contralateral shoulder is an additional support for avoiding this pitfall.

Musculotendinous Junction

The junction zone between muscle and tendon is a complex of interdigitating muscle and tendon fibers. The junction of the multipennate subscapular tendon is subject to a varying appearance. The hyperechoic tendon fibers are interposed with hypoechoic muscle fibers, which may be confused with tendinosis by less experienced radiologists

The infraspinatus tendon is centrally positioned in the infraspinatus muscle. The surrounding hypoechoic muscle fibers may be confused with a tendon tear, especially when the tendon is scanned obliquely. Normal rotator cuff tendons occasionally contain slight inhomogeneities. Histologically, they consist of a complex of five layers, which have a fibrocartilaginous attachment at the humeral tuberosities.

Vahlensieck et al (34) and Turrin and Cappello (35) reported that the supraspinatus muscle consists of two distinct portions: an anterior fusiform (cylindrical) portion that contains the dominant tendon and a straplike (flat) posterior portion. This causes a fanning out and running in slightly different directions of the fascicles of the supraspinatus tendon. The differently oriented tendon fascicles and complex

interdigitation of muscle fibers between the anterior and posterior parts of the tendon result in varying echogenicity of the supraspinatus tendon; this varying echogenicity may be mistaken for tendinosis or a tear.

Fibrocartilaginous Insertion

The attachment site of tendons may contain an amount of fibrocartilage . This is related to the orientation of the tendon fibers with regard to the bony attachment site. The more the fibers follow a perpendicular course, the higher the content of fibrocartilage in the attachment zone. As with hyaline cartilage, the cartilage in the attachment zone appears hypoechoic. This may result in a thin hypoechoic zone in the tendon insertion near the hyperechoic reflection of the cortical bone. Familiarity with the anatomy will prevent a false-positive diagnosis like tendinosis or rotator cuff tear . The low echogenicity of the fibrocartilage attachment zone is reinforced by the anisotropy of the tendon fibers in this zone, which are curved and parallel with regard to the insonating ultrasound beam.

Nondiastasis of the Ruptured Tendon Fibers.

A recent partial- or full-thickness tear is accompanied by fluid (ie, hematoma). The surrounding fluid enhances the ultrasound signal, which

is favorable for the depiction of rotator cuff tears. In a long-standing tear, fluid may be absorbed. Partial- and full-thickness rotator cuff tears in which the ruptured tendon fibers do not recede may then be more difficult to depict.

DISEASE-RELATED CAUSES OF MISINTERPRETATION

Definition of and Criteria for Rotator Cuff Tears

The US appearances of rotator cuff tears overlap partly with the spectrum of appearances of normal variation and/or other tendon abnormalities.

The criteria have been modified (36). A full-thickness rotator cuff tear is a defect in the tendon that reaches from the bursal to the articular margin. A partial-thickness tear is a focal discontinuity at the bursal or articular margin or is located intratendinously. Brandt et al (36) showed that echogenic foci or bands are not reliable criteria for rotator cuff tears. These hyperechoic foci represent calcification, fibrotic scar tissue, synovitis, or hemorrhage. Partial- and full-thickness rotator cuff tears are visualized as hypoechoic lesions or mixed hyper- and hypoechoic lesions most frequently located in the critical zone of the supraspinatus tendon and should be verified in two orthogonal directions.

Secondary or indirect signs are reliable criteria for the detection of rotator cuff tears (37) . Partial-thickness tears are frequently accompanied by cortical outpouchings (pitting) at the insertion of the rotator cuff tendons . Fluid in the glenohumeral joint is associated with the presence of rotator cuff tear in 60% of cases . When fluid is present in the subacromial- subdeltoid bursa and in the glenohumeral joint, the probability of a rotator cuff tear is 95%(38) . In patients with a fluid-filled widened subacromial-subdeltoid bursa, a tear is apparent in 70% to more than 90% of cases.

Other indirect signs of partial- or full-thickness rotator cuff tears are the ability to compress the deltoid muscle into a cuff defect or against the humeral head (naked tuberosity sign) and a bright aspect of the humeral cartilage (cartilage interface sign or uncovered cartilage sign), which is caused by enhancement of the ultrasound signal due to fluid and loss of cuff tissue above the cartilage.

Tendon Inhomogeneity.

Inhomogeneities of the tendon are frequently encountered with degenerative changes of the tendon (ie, tendinosis) .In our experience, the combination of tendinosis and anisotropy is the most common cause

of a false-positive diagnosis of a partial-thickness rotator cuff tear.. Power Doppler US may be of help by demonstrating low-flow hyperemia associated with tendinosis , in contrast to no flow in a full-thickness rotator cuff tear.

Acoustic Shadowing by Scar Tissue or Calcification.

Trauma or surgery may also cause fibrosis or scarring of the soft tissues around the shoulder. Behind these lesions, acoustic shadows may occur . Intratendinous or intrabursal calcium deposits manifest as focal echogenicity and acoustic shadowing. Because of its structure (eg, milk of calcium) or size, calcification may not always cause well-defined acoustic shadowing. Correlation with plain radiographs is necessary to recognize these deposits and prevent misinterpretation of the hypoechoic shadowing zone as a rotator cuff tear . Acoustic shadowing is also proportionate to transducer frequency.

Rotator Cuff Thinning.

Focal thinning of the rotator cuff is a feature of a partial-thickness rotator cuff tear, but it is also anatomy related and related to atrophy due to factors such as rheumatoid arthritis, disuse, nerve impingement, or surgery(39) . Comparison with the contralateral side may be of help in

differentiation from a rotator cuff tear. However, one should keep in mind that in a symptomatic shoulder without a rotator cuff tear or with a partial-thickness rotator cuff tear, there is a 0.5%–4.3% prevalence of a contralateral tear; with a full-thickness tear, there is a 35.5% prevalence of a full-thickness tear on the asymptomatic side . The average thickness of an intact rotator cuff is approximately 4.7 mm . There is a slight but not significant difference in rotator cuff thickness between the dominant limb (range, 3.6–7.0 mm; mean, 5.3 mm) and nondominant limb (range, 3.2–7.0 mm; mean, 5.1 mm) . The rotator cuff thickness is not related to age, gender, or symptoms.

Tendinosis

Neer(41) described three stages in the pathogenesis of the impingement syndrome. A spectrum of sonographic abnormalities of the rotator cuff tendon are likely to correlate with edema, hemorrhage, tendinosis, fibrosis, and rotator cuff tear caused by the impingement syndrome.

In tendinosis, a tendon can appear hypoechoic due to an increased amount of fluid and/or amyloid deposits in and between the tendon fibers . The hypoechoic appearance decreases when one scans with too

much gain and increases when one uses too little gain or in combination with anisotropy. Tendinosis is often coexistent with partial-thickness rotator cuff tears. These may be difficult to detect when they are located in an area of tendinosis.

Calcifications.

With long-standing impingement (ie, chronic tendinosis), calcium may be deposited in the rotator cuff tendons and/or the subacromial-subdeltoid bursa. Most patients with calcifying tendonitis are 30–50 years old, a much younger age group than those who develop rotator cuff tears. These deposits may be uni- or multilocular and have a varying hyperechoic aspect and/or acoustic shadow. These calcifications appear in the critical zone of the tendon, where most tears tend to occur. Tears may be obscured by shadowing from these calcifications. Therefore, plain radiographs should be available prior to sonographic examination.

Synovial Proliferation, Granulation or Scar Tissue.

Synovial, granulation, and scar tissue can have varying echogenicities. Bretzke et al (33) stated that focal areas of increased echogenicity are a feature of rotator cuff tear. However, most focal hyperechoic areas in the rotator cuff are due to degenerative changes of

tendon fibers (fibrosis in chronic tendinosis), scar tissue, or calcium deposits. Granulation or scar tissue and intraarticular or bursal synovial tissue may fill in partial- or full-thickness rotator cuff tears, thereby impeding sonographic visualization.

Thickened Bursa Mimicking the Rotator Cuff.

The synovial tissue of the subacromial-subdeltoid bursa can thicken substantially with (chronic) bursitis or due to synovitis in patients with rheumatoid arthritis. These thickened bursal layers may mimic the rotator cuff or fill in a partial- or full-thickness rotator cuff tear. As in conventional arthrography, this is one of the causes of a false-negative finding. Compression with a transducer would be useful in making a diagnosis of a full-thickness rotator cuff tear in these cases.

Massive Rotator Cuff Tear

Most rotator cuff tears are located in the supraspinatus tendon and may extend to the infraspinatus or subscapular tendon. With massive rotator cuff tears, the cuff cannot be visualized at US because it has completely avulsed off the greater tuberosity and retracted under the acromion. When the rotator cuff is missing, the deltoid muscle lies directly on the humeral head or is separated from the humeral head by a

fluid layer . Missing the diagnosis can be overcome by counting the layers around the humeral head. Normally, three layers can be recognized: the subcutaneous tissue, deltoid muscle, and rotator cuff. The thickness of these layers may vary due to several factors, for instance, obesity or muscle and tendon atrophy. The outside of the subcutaneous tissue is bordered by a small hyperechoic line representing the cutis.

The deltoid muscle and the rotator cuff are separated by a small hyperechoic layer representing the peribursal fat line and the subacromial-subdeltoid bursa. The small hypoechoic line on the inside of the rotator cuff following the contour of the humeral head represents the hyaline cartilage of the humeral head. The deltoid muscle and rotator cuff can be easily differentiated because the deltoid muscle extends over the humeral head and greater tuberosity to insert on the proximal lateral humeral shaft, whereas the normal rotator cuff tapers and inserts on the greater tuberosity. In some cases, the space left by the missing rotator cuff may be filled in by fluid (echogenic due to debris) and/or proliferating synovial tissue mimicking the rotator.

PATIENT-RELATED CAUSES OF MISINTERPRETATION

Obesity or Muscularity

The depiction of rotator cuff tears in obese or muscular patients may be limited or insufficient. Despite the development of high-frequency transducers and especially the improvement of resolution and penetration depth, it may still be difficult to evaluate the rotator cuff of an obese or muscular patient sonographically. The fatty tissue layer or large deltoid muscle absorbs too much of the emitted high-frequency (ie, low-energy) sound waves. However, large tears can readily be diagnosed. To overcome this problem, it rarely may be necessary to use a lower-frequency transducer. Inherent to lower frequencies is a decrease in spatial resolution, which limits the reliable depiction of rotator cuff tears and therefore the accuracy of the examination.

Limited Shoulder Motion

Full assessment of the rotator cuff is difficult in patients with shoulder pain and/or disability. In our experience, this problem can be overcome by physical support of the arm movements by the examiner and by moving the arm slowly and performing the examination quickly. This especially applies to the external rotation (ie, subscapular tendon) and hyper-extension-internal rotation (ie, supraspinatus tendon)

positions. Alternatively, the rotator cuff can be evaluated with the arm hanging beside the body, preferably with maximal hyperextension.

REVIEW OF LITERATURE

Crass et al (42) and **Middleton et al** (32) in 1984 were the first to describe ultrasonographic (US) evaluation for rotator cuff tears, and US has proved to be as accurate as magnetic resonance (MR) imaging in the detection of supraspinatus tendon tears. In a recent study comparing US with MR imaging and using arthroscopy as the standard of reference.

Teefey et al (6) demonstrated an overall accuracy of 87% for both modalities in correctly identifying partial- and full-thickness rotator cuff tears as well as the absence of such tears. In that study, US helped correctly identify 45 of 46 full-thickness tears and 13 of 19 partial-thickness tears, whereas MR imaging helped correctly identify all 46 full-thickness tears and 12 of 19 partial-thickness tears. The reported accuracy, sensitivity, and specificity of US in the detection of any tear, whether partial or full thickness, are all greater than 90%

Litaker et al (44) showed that weakness of external rotation, patient age of at least 65 years, and night pain best helped predict the presence of partial- or full-thickness rotator cuff tear. Other clinical findings that these authors found most useful included weakness of abduction, impingement, and the "arc of pain" sign (pain during descent

of the abducted arm). Weakness of external rotation, night pain, weakness of abduction, impingement, and the arc of pain sign had a sensitivity and a positive predictive value of 76% and 79%, 88% and 70%, 64% and 78%, 97% and 67%, and 98% and 67%, respectively . Weakness of abduction, impingement, and the arc of pain sign should be expected because rotator cuff tears usually involve the supraspinatus tendon. Weakness of external rotation is a sign of infraspinatus tear.

Dinnes et al (45) recently reviewed 10 cohort studies on the clinical evaluation of the shoulder. Pooled data from four of these studies suggested that clinical examination as a whole has a sensitivity of 90% and a specificity of 54% in the detection of full-thickness rotator cuff tears. Although 23 different signs, symptoms, and tests were assessed in the 10 studies, no definite conclusion about individual tests could be reached, since too few studies evaluated any one test. In addition, there is some variability in how individual tests are performed . Nevertheless, a few studies have identified the most useful clinical tests for rotator cuff tears.

Murrell and Walton et al (43) reviewed 23 clinical examinations for rotator cuff tears and found that supraspinatus weakness, weakness of external rotation, and impingement were positive and the patient is at

least 60 years old, the chance of partial- or full-thickness rotator cuff tear is 98%.

Van Holsbeeck et al (31) reported a sensitivity and a specificity of 93% and 94%, respectively, for detection of partial-thickness tears of the rotator cuff at US.

DeOrio and Cofield et al (44) classified rotator cuff tears on the basis of greatest dimension as either small (<1 cm), medium (1–3 cm), large (3–5 cm), or massive (>5 cm).

Dussik et al (24) was the first to describe anisotropy of fibres which is a common cause of false positive diagnosis of rotator cuff tears.

Bretzke et al (33) showed that thinning of rotator cuff at the supraspinatus –infraspinatus interface is a normal finding and should not be mistaken for a partial thickness tear.

Vahlensieck et al (34) and **Turrin and Cappello** (35) reported that the supraspinatus muscle consists of two distinct portions: an anterior fusiform (cylindrical) portion that contains the dominant tendon and a straplike (flat) posterior portion. This causes a fanning out and running in slightly different directions of the fascicles of the

supraspinatus tendon. The differently oriented tendon fascicles and complex interdigitation of muscle fibers between the anterior and posterior parts of the tendon result in varying echogenicity of the supraspinatus tendon; this varying echogenicity may be mistaken for tendinosis or a tear.

Brandt et al (36) showed that echogenic foci or bands are not reliable criteria for rotator cuff tears. These hyperechoic foci represent calcification, fibrotic scar tissue, synovitis, or hemorrhage. Partial- and full-thickness rotator cuff tears are visualized as hypoechoic lesions or mixed hyper-and hypoechoic lesions most frequently located in the critical zone of the supraspinatus tendon and should be verified in two orthogonal directions.

Crass et al (47) and **Mack et al** (48) showed that in the postoperative shoulder, the rotator cuff is more echogenic than in the normal shoulder due to fibrosis or granulation tissue and that the soft-tissue planes are distorted or absent.

Neer et al (41) described three stages in the pathogenesis of the impingement syndrome. A spectrum of sonographic abnormalities of the rotator cuff tendon are likely to correlate with edema, hemorrhage, tendinosis, fibrosis, and rotator cuff tear caused by the impingement syndrome.

MATERIALS AND METHODS

The purpose of this study is to identify USG abnormalities in patients with shoulder pain and to compare physical examination with USG findings. US images of the shoulder were evaluated for joint fluid, subacromial – subdeltoid bursal fluid, abnormal tendon echogenicity, tendinosis, and calcific tendinitis.

Fifty two patients with shoulder pain attending the OPD department between September 2006 to October 2007 at Barnard Institute of Radiology, were prospectively studied. Sex age, duration and number of recurrences of shoulder pain were recorded.

The physical examination of shoulders were performed as follows.(1)area of tenderness (2)range of passive &active motion for abduction, forward flexion, external rotation & internal rotation(3)tests for impingement (4) manueveres for determining the location of the tendon lesion.

Transverse &longitudinal planes for long head of the biceps, supraspinatus, infraspinatus & subscapularis tendons ,subscapularis subdeltoid bursa & the glenohumeral & acromioclavicular joint were

included for US examination. US examination leads to an anatomical diagnosis of shoulder pain in many patients.

Inclusion criteria

Patients with shoulder pain

Exclusion criteria :

- 1) Patients with rheumatoid arthritis were excluded from the study for a separate imaging study of rheumatoid shoulder.
- 2) Patients who developed shoulder pain after previous trauma in the shoulder were also excluded.

EQUIPMENT

Gray scale sonography were performed using a 3500 series ALOKA unit equipped with a wide bandwidth (range 6 - 13 MHz) linear array transducer.

US Technique

A high-frequency (preferably 10– 12-MHz) linear transducer is used. Tissue harmonic imaging can also be used because it has been shown to increase the conspicuity of tears, although not diagnostic

accuracy . The ultrasound beam should be perpendicular to the tendon because even slight angulation can create artifactual hypoechoic to anechoic defects simulating tears . This artifact is called anisotropy, a phenomenon that is created when the interrogating ultrasound beam is not perpendicular to the highly organized parallel tendon fibers.

The US examination begins with evaluation of the biceps and subscapularis, then of the supraspinatus, and finally of the posterior structures, including the infraspinatus, teres minor muscle, and posterior glenohumeral joint. At our institution, the patient is seated on a revolving stool facing the examiner, although some examiners prefer to scan from the side or from behind the patient. The clavicle, acromioclavicular joint, and spine of the scapula are useful bone landmarks.

US evaluation of the biceps tendon.: The forearm is supinated and placed on the thigh, bringing the bicipital groove forward. In the transverse plane, the biceps tendon is seen in the bicipital groove between the greater and lesser tuberosities . Turning the transducer longitudinally makes the biceps tendon appear as hyperechoic fibrillar lines interposed between the deltoid muscle and the humerus . The

tendon can be followed from its musculotendinous junction to and then around the humeral head.

US evaluation of the subscapularis tendon:

The patient's arm is externally rotated, making sure to keep the elbow as close to the body as possible . This maneuver brings the tendon into a more anterior position. Rotating the transducer 90° so that it is oriented transverse to the arm allows the longitudinal extent of the subscapularis tendon to be seen as the tendon inserts on the lesser tuberosity). Some fibers extend across the bicipital groove to form the transverse humeral ligament, which anchors the extraarticular portion of the long head of the biceps tendon in place. On transverse images, the individual tendon slips of the subscapularis tendon can be seen.

US evaluation of the supraspinatus tendon :

The patient's hand is placed either behind the back or on the buttock with the elbow pointed posteriorly. This position exposes the supraspinatus tendon by bringing it out from underneath the acromioclavicular joint and brings into view the insertion of the tendon on the superior aspect of the greater tuberosity. The US transducer should be oriented 45°, or approximately midway between the coronal

and sagittal planes, to demonstrate the longitudinal course of the supraspinatus tendon. The course of the spine of the scapula is a useful reference plane. The transducer is then rotated 90° to demonstrate the tendon in the transverse plane. In this plane, the deltoid muscle, which is hypo-echoic in hyperechoic fascial planes, is just deep to the subcutaneous fat. Underneath the deltoid muscle is the anechoic subacromial subdeltoid bursa surrounded by hyperechoic peribursal fat.

The supraspinatus tendon appears hyperechoic and fibrillar and sits directly on the humerus. A thin anechoic rim of cartilage covers the hyper-echoic bone cortex. Moving the transducer anteriorly around the curvature of the humeral head in the oblique transverse plane allows visualization of the hyperechoic biceps tendon. The biceps tendon is used as a reference point for determining the location and size of tears. The supraspinatus tendon is the 2.0–2.5 cm of cuff tissue immediately posterior to the biceps tendon, with the infraspinatus tendon more than 2.5 cm posterior. To evaluate the supraspinatus muscle, the transducer is positioned anterior and parallel to the spine of the scapula in the supraspinatus fossa.

US evaluation of the infraspinatus muscle and tendon and the posterior glenohumeral joint are evaluated. The arm is placed in the

same position as that used for evaluation of the biceps tendon. The transducer is positioned just inferior and parallel to the spine of the scapula, bringing the infraspinatus muscle into view. The infraspinatus muscle is then followed laterally as it crosses the posterior glenohumeral joint and becomes the tendon. The evaluation of the infraspinatus tendon can be optimized with internal rotation of the humerus by having the patient reach for the opposite arm. The posterior labrum is also demonstrated by moving the transducer medially in this orientation and appears homogeneous, hyperechoic, and triangular.

RESULTS AND OBSERVATION

Table 1 shows the baseline demographic characteristics of the subjects. The mean duration of shoulder pain was 8 months. The involvement was bilateral in 10 patients(20%). 5 were diagnosed with frozen shoulder,9 with shoulder tendinosis. Simple X-ray findings of the shoulder included 38 (76%) normal findings, 10 (20%) degenerative changes, 2 (4%) calcific tendonitis.

Baseline Characteristics of the Subjects

AGE :

50yrs (range 35 – 70yrs).Average age of the patient was 50 yrs.
62% of the patients were females and 38% were males.

TABLE – 1**SEX**

Sex	No. of Patients	Percentage
Female	31	62%
Male	19	38%

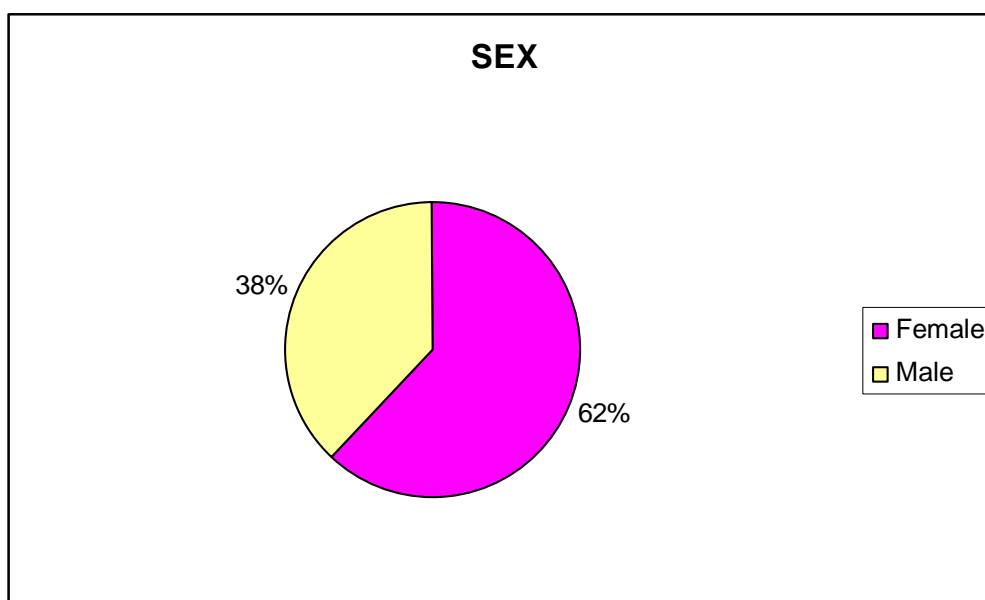


TABLE – 2
RADIOGRAPHIC FINDINGS

Findings	No. of Patients	Percentage (%)
Normal	38	76%
Degenerative Changes	10	20%
Calcific Tendonitis	2	4%

Radiograph of 38 patients were normal. 10 pts showed degenerative changes. 2 patients had calcific tendonitis.

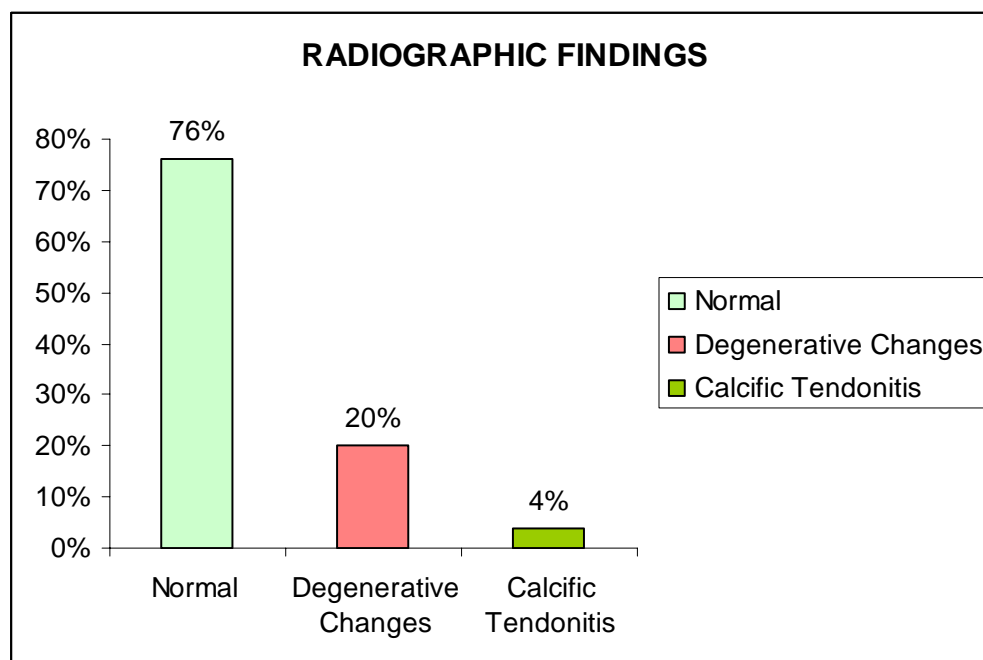


TABLE – 3**Positive physical examination findings of 50 Painful shoulders (%)**

TENDERNESS	No. of Patients	Percentage (%)
Glenohumeral	9	18%
Subacromial	36	72%
Bicipital	11	22%
Acromioclavicular	6	12%

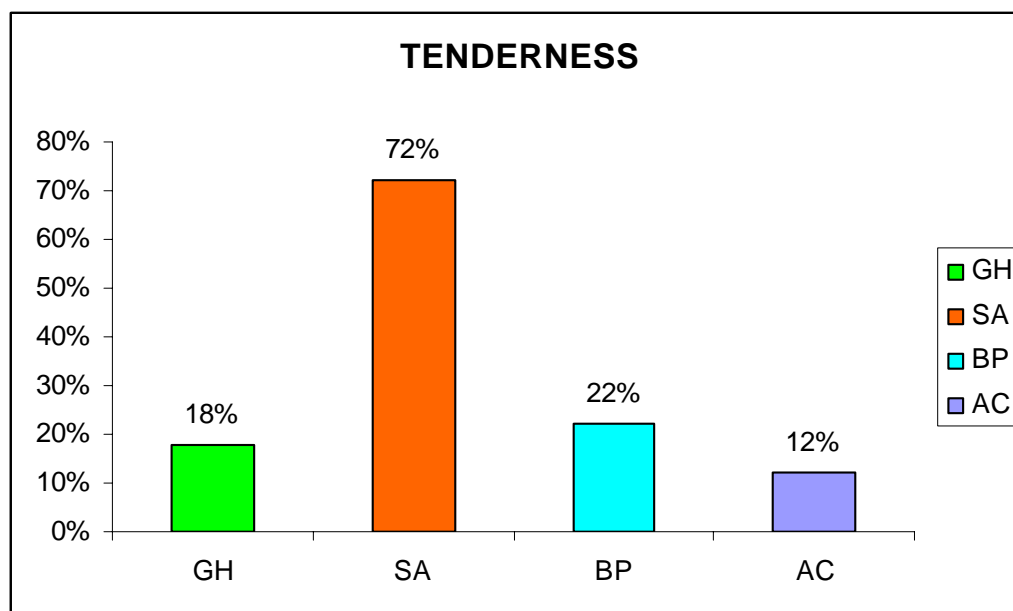


TABLE – 4
LIMITATION OF MOTION

LIMITATION OF MOTION	NO. OF PATIENTS	PERCENTAGE
Forward Flexion	9	18%
Abduction	45	90%
External rotation	29	58%
Internal rotation	3	6%
Impingement Test	5	10%
INDIVIDUAL MUSCLE TEST		
Jobe's (supraspinatus)	10	20%
Lift-off (Subscapularis)	2	0.4%

Table 3 & 4 shows the physical examination findings for the 50 painful shoulders. Range of motion most affected by shoulder pain in our patients was abduction, followed by external rotation and forward flexion. Impingement sign was positive in 10% the shoulders,. For the physical examination of individual muscles, positive Jobe's test, indicating supraspinatus lesion, was the most common.

TABLE – 5
US FINDINGS OF 50 PAINFUL SHOULDERS (%)

	NO. OF PATIENTS	PERCENTAGE (%)
LHB Effusion	24	48%
Subdeltoid effusion	10	20%
SST Thickening	7	14%
SST Partial Tear	8	16%
SST Calcification	2	4%
Impingement	4	8%
Subscapularis Partial Tear	1	2%
Humeral Bony Irregularity	2	4%

Table 5 lists US findings for the painful shoulders. The most frequent finding in our patients with painful shoulder was effusion in the long head of the biceps tendon, which was observed in 48% of the patients. Among the rotator cuff tendons, except for the teres minor which was not included in our US examination, supraspinatus was the most frequently involved, with tendon tear observed in 8 (16%) of the shoulders. Subscapularis tendon tear was observed in 1 shoulder (2%). Infraspinatus tear was not observed. Impingement sign as depicted by

“bunching” or cog-wheel hesitation of the rotator cuff tendons during active forward flexion and abduction of the glenohumeral joint was noted in 5 (10%) shoulders. Calcification in the supraspinatus tendon was observed in 2 (4 %) shoulders. Ten shoulders exhibited subdeltoid effusion, of which 1 depicted partial tear of the supraspinatus tendon.

10 patients showed clinical examination suggestive of tear of which 8 patients had USG confirmed tear.

DISCUSSION

USG can be used to evaluate the causes of shoulder pain without ionising radiation. High frequency transducer is used for this purpose.

A total of 50 patients formed the study group. This included 31 (62%) females and 19(38%) males. Most of the patients in the study group belonged to 4th and 5th decade. The commonest complaint in this study was shoulder pain followed by restriction of movements.

US images were of relatively good quality. The anatomy of tendons, bursae and muscle were seen well. Posterior labrum was visualized. Us is not effective for visualizing labrum pathologies for which MR arthrogram is useful. US images were analysed for various pathologies as a cause of shoulder pain which was not evident on clinical communication.

SSI Tear

Ten patients showed partial tear of SST and those who had tear were subjected to MRI and finding confirmed. As MR is expensive not all patients were subjected to this modality. On clinical examination only 8 patients were suspected to have tear.

The high prevalence of tendon tear in our patients might be related to higher age and selection bias associated with rheumatologic practice. Although errors in the detection and measurement of rotator cuff tears by US examination do occur, a recent report comparing ultrasonography and arthroscopy has shown that the majority of errors involved missing of tendon tear. In addition, we diagnosed tendon tear conservatively only after verifying defects in echo in the two perpendicular direction.

LHB tendon effusion

This was the most common finding detected on USF 48% of the patients had LHB effusion. This was not detected on clinical examination.

Subacromial Subdeltoid effusion

10 patients were shown to have bursitis clinical examination could not reveal the pathology.

In this study of patients with shoulder pain, US abnormalities in the shoulder were common, with 16% of the shoulders showing rotator cuff tendon tears. The most frequent US finding of shoulder joints in our patients was effusion in the long head of the biceps tendon. Among the

rotator cuff tendons, supraspinatus was the most frequently involved, followed by subscapularis, although infraspinatus tendon tear was not noted. Out of 20% patients who were suspected to have SST tear, 16% of patients had US detected tear of SST tendon.

The frequency of abnormal US findings of painful shoulder joints differs depending on the patient population studied. In a European study evaluating 425 patients with a mean age of 57.9 years, US abnormalities were found in a total of 94.1% of patients, with the supraspinatus tendon showing the most frequent abnormalities, followed by the long head of the biceps and acromioclavicular joint. In our study, evaluating 50 patients, alterations were detected in the various structures of the shoulder, including, subacromial–subdeltoid bursa, and periarticular tendons in 41 patients.

In a Korean USG study evaluating 49 patients with shoulder pain and positive impingement sign, 32.7% had abnormalities. The partial thickness tear of supraspinatus tendon was the most frequent finding, followed by biceps effusion, fluid collection in subacromial bursa, and full thickness tear of the supraspinatus.

In another Korean US study evaluating 21 asymptomatic baseball players (14.3%) showed abnormality in the dominant shoulder, with focal bony irregularity at the insertion of the supraspinatus, focal low echoic lesion in the supraspinatus, and fluid collection in acromioclavicular joint in one subject each.

In line with previous reports, our results show that the clinical examination of the painful shoulder is not accurate. Norwood et al tried to define the clinical signs and symptoms that indicate the presence of a rotator cuff tear and predict its severity. They found that the characteristics of the pain and the site of tenderness were not helpful, nor was the weakness to resisted abduction. The low sensitivity and specificity of physical examination may be owing to the fact that most patients with chronic shoulder pain have multiple periarticular lesions, usually involving different tendons, the subacromial–subdeltoid bursa, and impingement syndrome. Clinical examination may be supplemented by plain radiography; however, except for the delineation of degenerative changes and calcifications, the findings are usually nonspecific. In a study involving 206 patients visiting the emergency room for shoulder pain, 88% of the simple shoulder radiographs were

found to be therapeutically uninformative. At present, MRI has been widely used to evaluate painful shoulders.

MRI was better able to reveal full-thickness tear of the supraspinatus tendon and joint inflammation, whereas ultrasonography showed other changes of the supraspinatus tendon (degeneration or partial-thickness tear) better. In a more recent report, however, there were no significant differences between MRI and ultrasonography with regard to the correct identification of a full-thickness tear or its size, reflecting the improvement in the quality of the US equipment and the protocol for the evaluation of the shoulder. Errors in US diagnosis most often consisted of an inability to distinguish between partial and full-thickness tears that are approximately 1 cm in size, which did not significantly affect the planned surgical approach.

Although ultrasonography offers considerable benefit for the proper valuation of shoulder joint problems, limitations such as a lack of visualization of the posterior aspect of the rotator cuff tendons, limited view of the glenohumeral joint, and considerable dependence on the operator exist. In our study, gold standard for the diagnosis of tendon tear, such as arthroscopy or MRI, was not included as it was expensive. Therefore, our US estimation of tendon tear may not be

precise. However, in 10 patients who underwent MRI for further evaluation following US examination, the correlation for tendon tear was excellent. The primary purpose of this study was to define the differences between clinical examination and US examination of the shoulder, and further study comparing US and MRI for the evaluation and the treatment of patients with shoulder pain is warranted. Aside from medical treatment, conservative treatments of shoulder problems include physiotherapy and local injections of corticosteroids. Few studies have evaluated the differences in the outcome of the different periarticular lesions with or without diagnosis by an accurate imaging technique.

CONCLUSION

US is well established and is the initial modality of choice to diagnose rotator cuff pathologies.

Main reason for failure of clinical examination is inability to diagnose the various causes of shoulder pain.

US using high frequency transducer of atleast 7.5 mHz can produce high accuracy regarding the various abnormalities in the shoulder compared to clinical examination.

US is inexpensive, non - ionising, easily available and also used for therapeutic purpose like steroid injection into the subacromial bursa and biceps tendon sheath which causes pain relief and improvement in the range of motion.

US can be used as screening test for evaluation of shoulder pain as MRI is expensive.

Clinical examination taken for evaluation of shoulder pain can suggest the diagnosis of rotator cuff tear. US can help confirm the presence of rotator cuff tear and help diagnose other potential causes of pain like long head of biceps effusion, subacromial–subdeltoid effusion, tendinosis, calcific tendonitis. MRI is the gold standard and can be used to confirm lesions in cases of ambiguity.

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ABBREVIATIONS

TN	TENDERNESS
RM	RESTRICTED MOTION
IT	IMPINGEMENT TEST
MT	MUSCLE TEST
LHB	T LONG HEAD OF BICEPS ENDON
SA-SD	SUBACROMIAL SUBDELTOID
PT-SST	PARTIAL TEAR SUPRAPINATUS TENDON
DC	DEGENERATIVE CHANGES
SA	SUBACROMIAL SUBDELTOID
GH	GLENOHUMERAL
BP	BICIPITAL
ER	EXTERNAL ROTATION
AB	ABDUCTION
FF	FORWAD FLEXION
CT	CALCIFIC TENDINITIS

PROFORMA

Name : Age :

OP No :

Address :

Socio economic status :

Presenting complaints :

Shoulder pain

Weakness and restricted motion

Clicking , catching, stiffness and crepitus

Past history

h/o trauma

h/o connective tissue disease

Personal history

Smoking

Alcoholism

General examination

Build

Nourishment

Weight

Vitals : pulse rate

Blood pressure

CVS

RS

LOCAL EXAMINATION :

INSPECTION position of arm

Contour - flattening

Rounded and fullness

PALPATION Tenderness : Subacromial

Glenohumeral

Bicipital

Acromioclavicular

RANGE OF MOVEMENTS

Forward flexion

Abduction

External rotation

Passive motion greater than active

IMPINGEMENT TEST

INDIVIDUAL MUSCLE TEST

INVESTIGATION

Plain radiography : calcification

Subacromial sclerosis

Osteophyte formation

Reduction of the acromiohumeral distance(<7mm)

USG :Tear : partial thickness

Full thickness

Subacromial subdeltoid bursal fluid

Cortical irregularity

LHB effusion

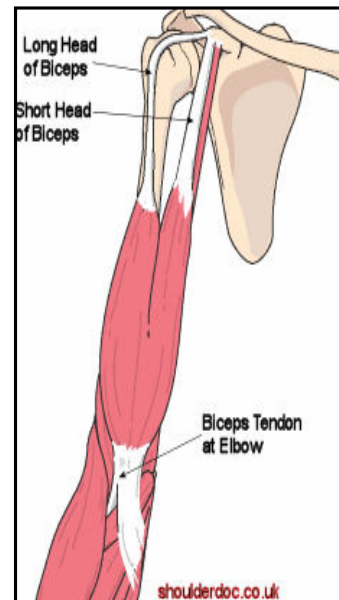
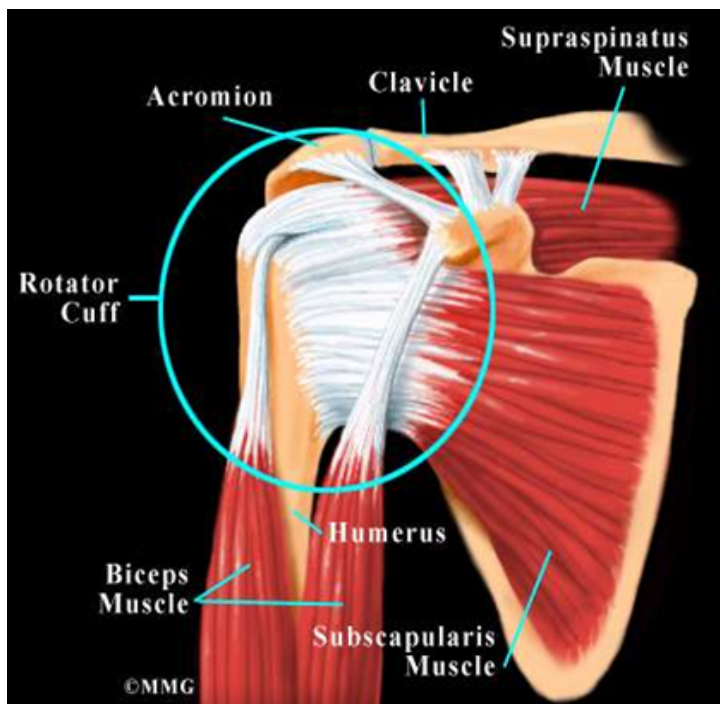
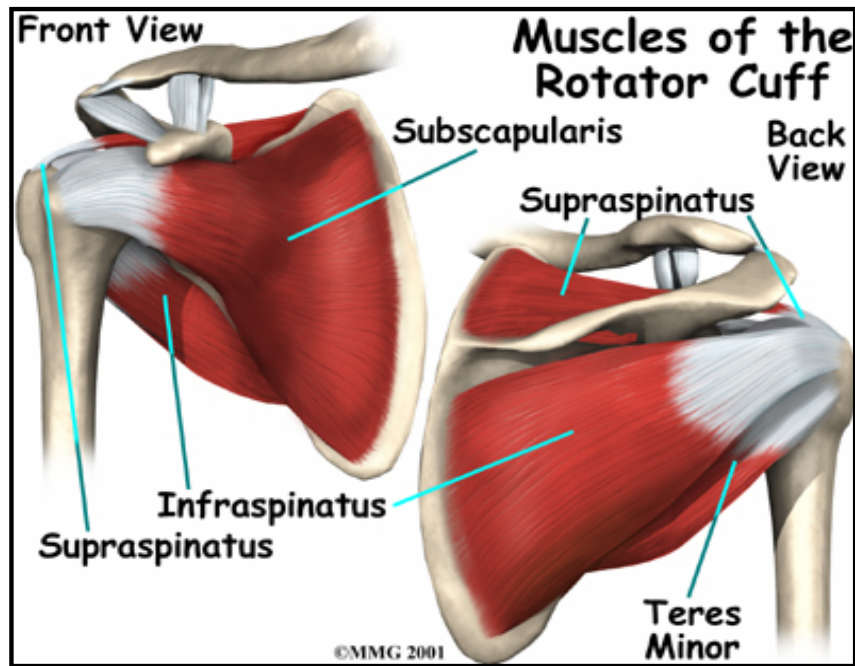
Calcific tendonitis

Tendon thickening

PROVISIONAL DIAGNOSIS

IMPRESSION

ANATOMY OF SHOULDER JOINT

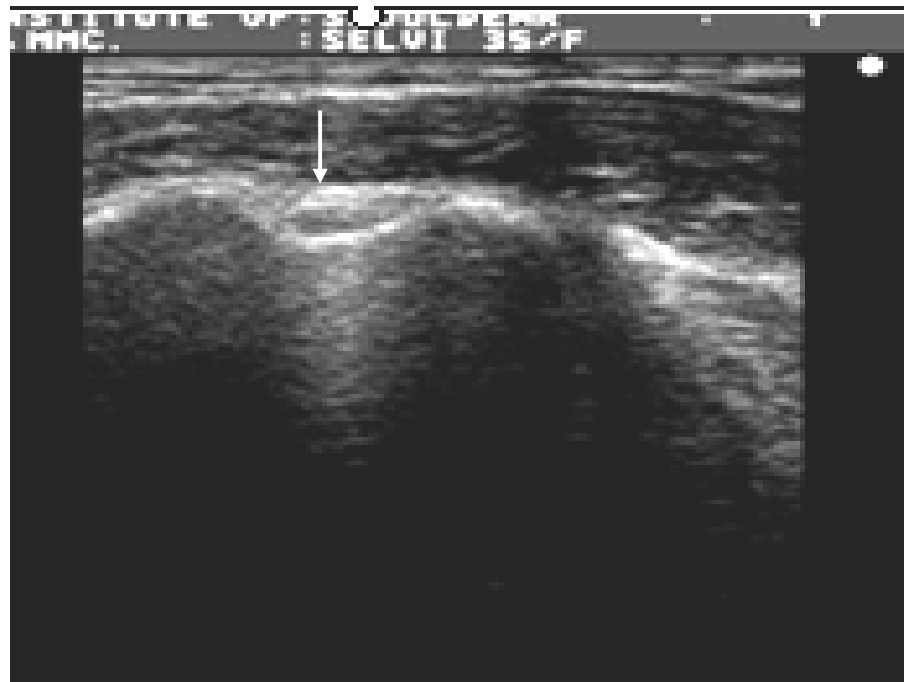


ALOKA - 3500



LHB TENDON – NORMAL

TRANSVERSE VIEW



LONG VIEW



LHB EFFUSION –LONG VIEW



EFFUSION - TRANSVERSE VIEW



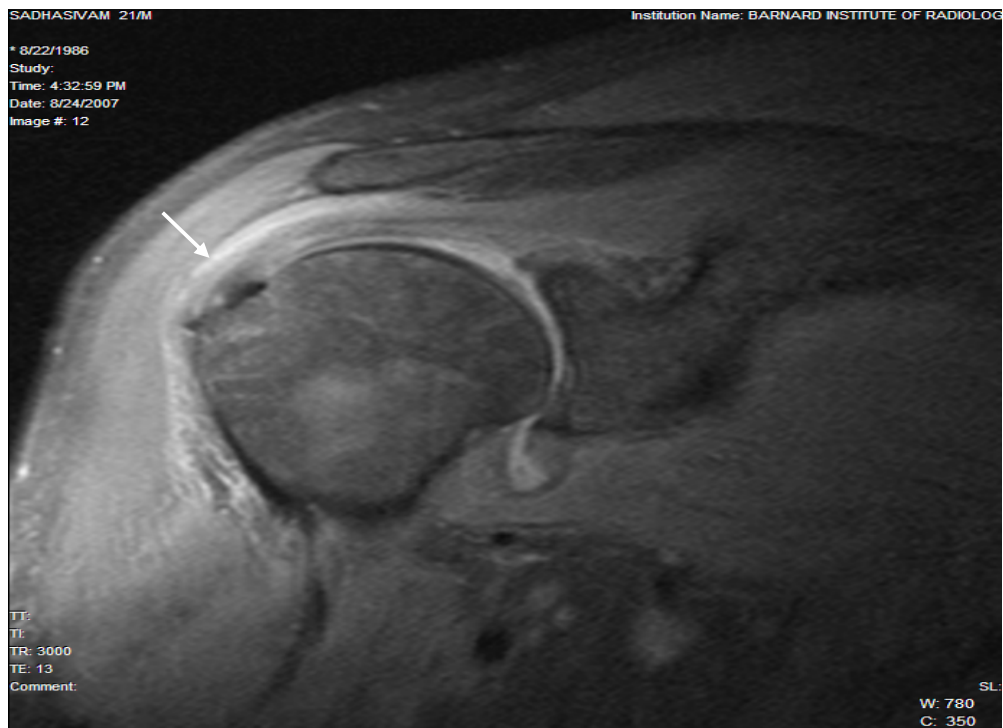
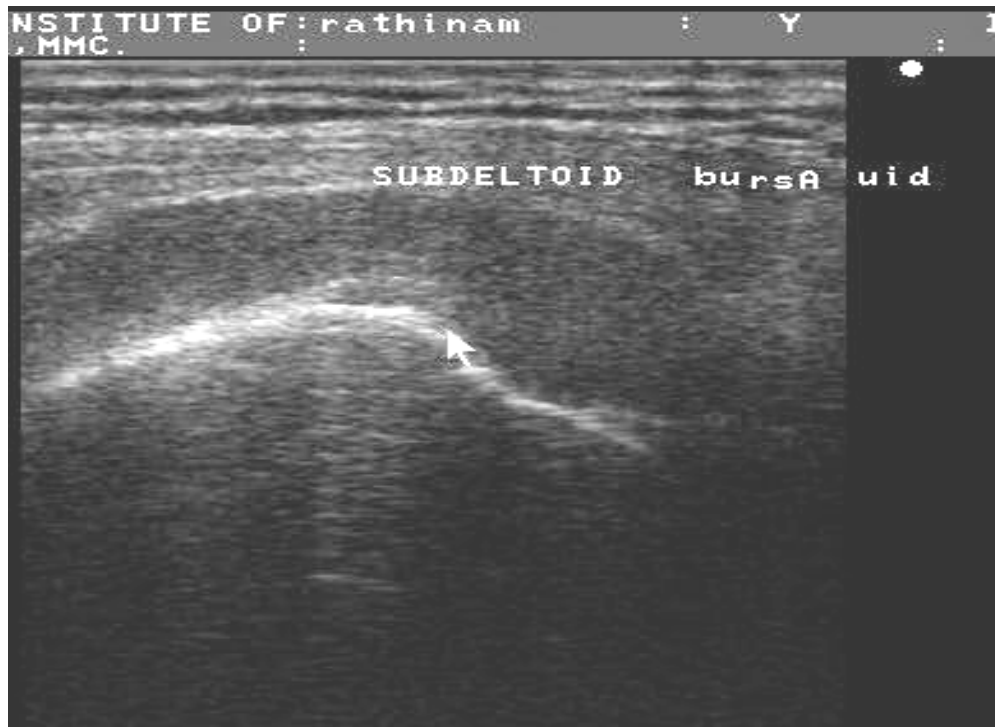
SA -SD BURSA NORMAL



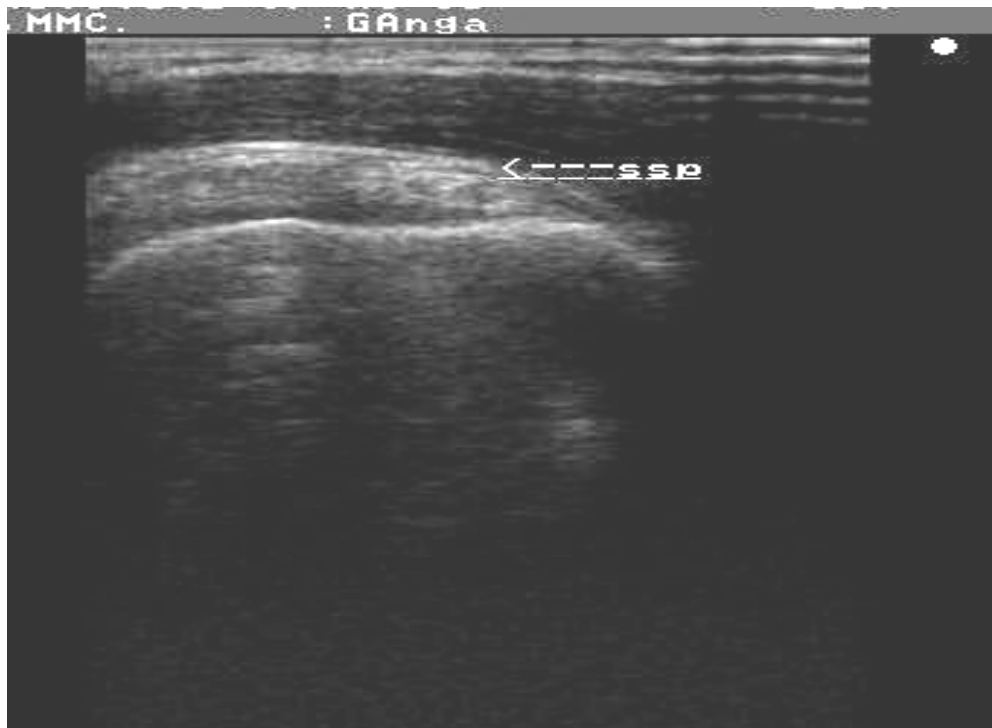
SA -SD BURSITIS



SA – SD BURSITIS



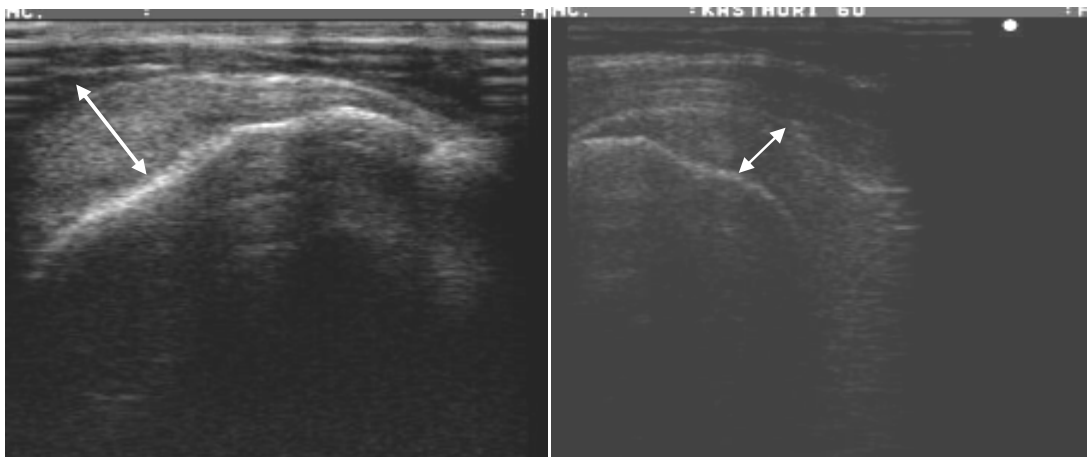
SST –NORMAL LONG VIEW



SST -TENDINOSIS

ABNORMAL

NORMAL

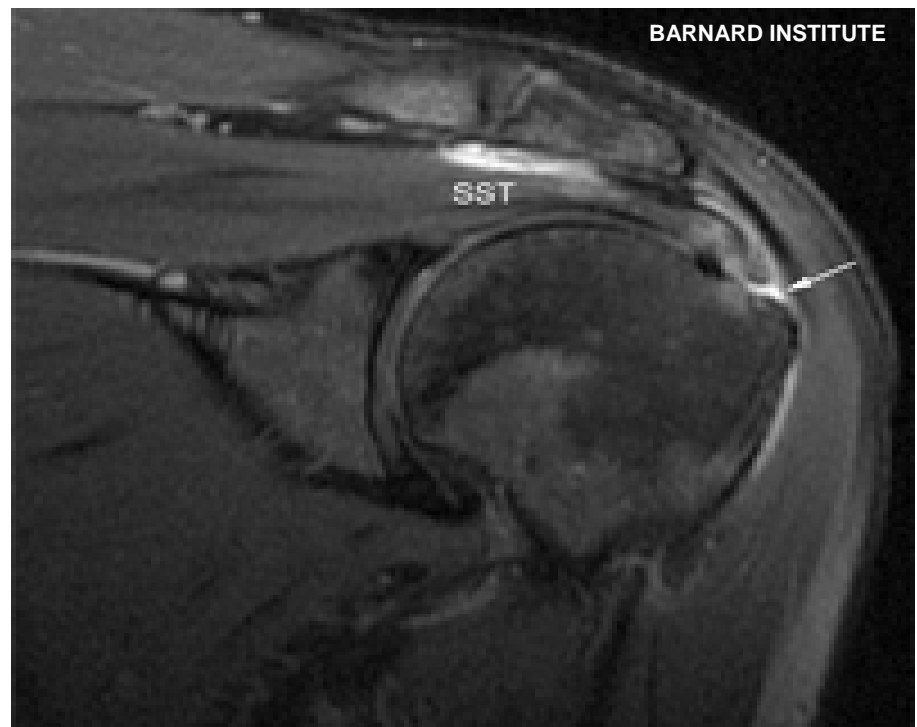


SST-TEAR

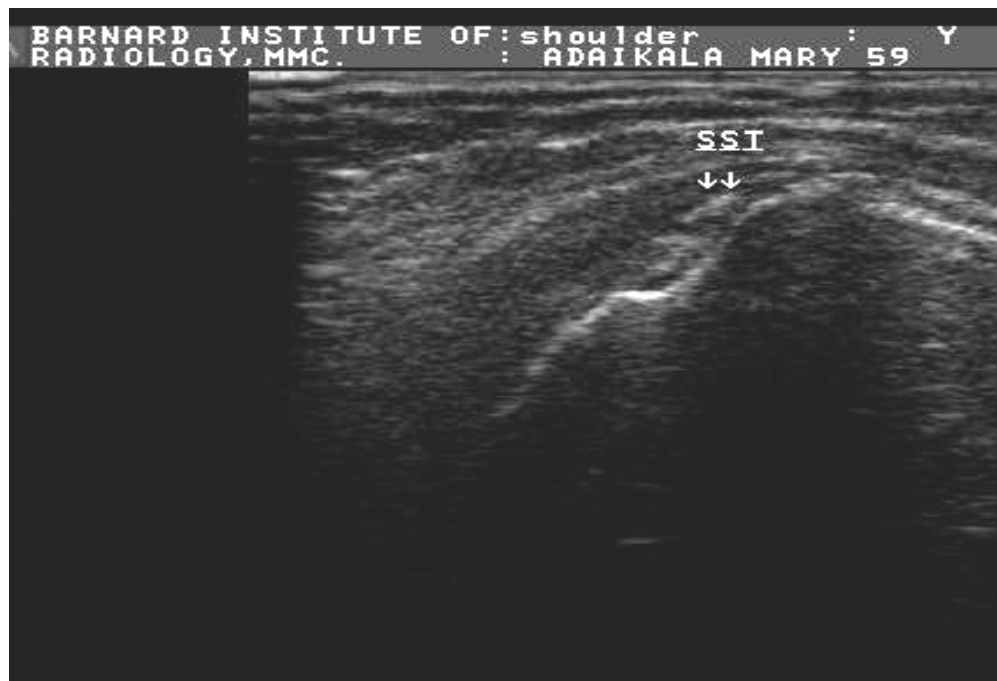
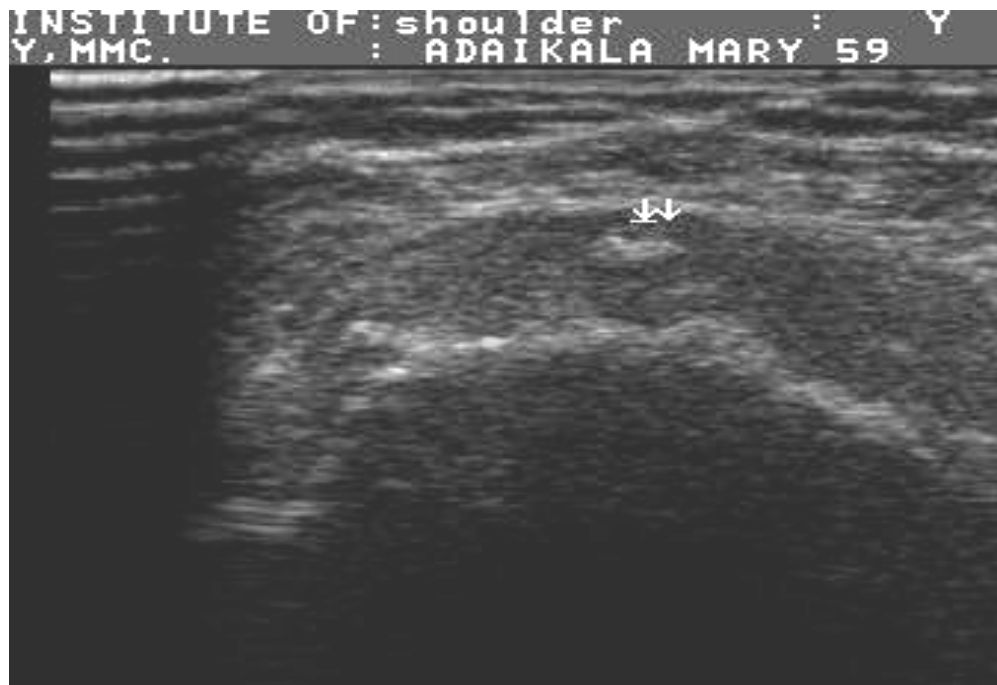


SAGGING PERIBURSAL FAT SIGN

SST- PARTIAL TEAR



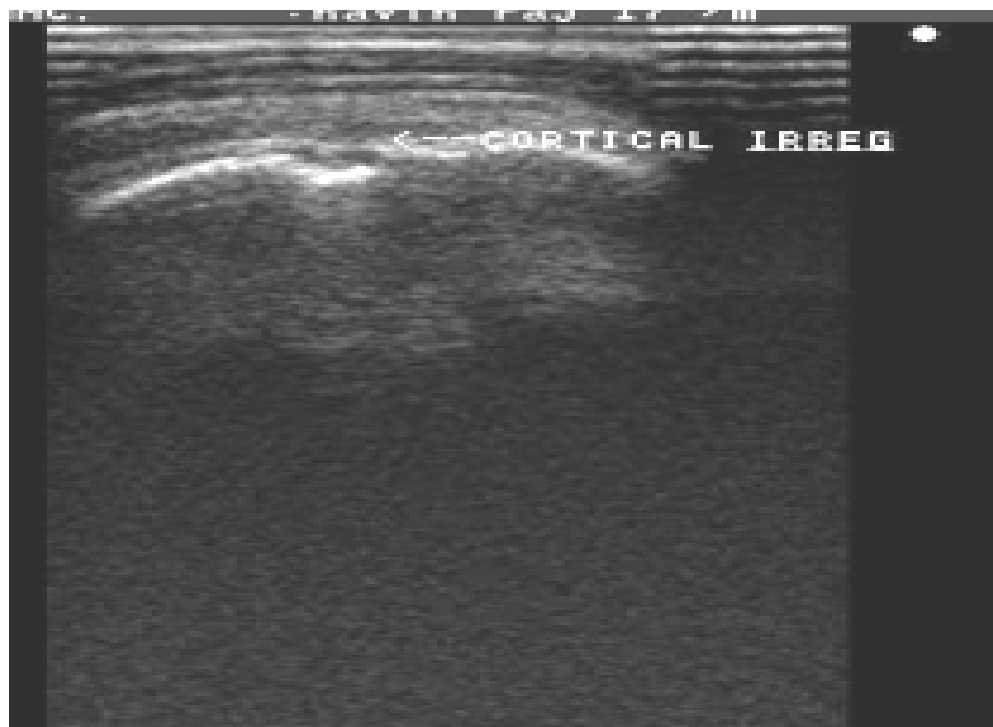
SST CALCIFIC TENDINITIS



AC JOINT NORMAL



CORTICAL IRREGULARITY



IST -NORMAL

